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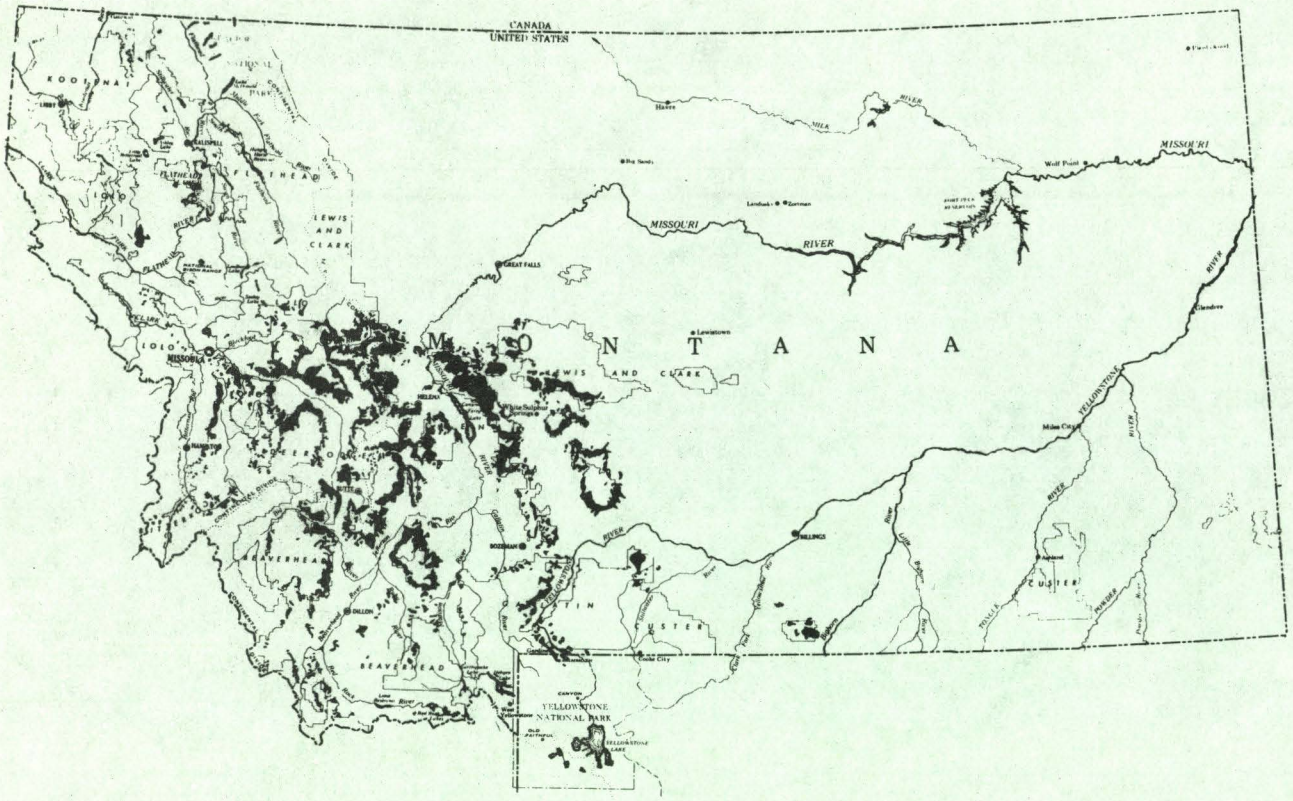

FOREST PEST CONDITIONS AND PROGRAM HIGHLIGHTS

1987

REPORT 88-2

MAY 1988

USDA
Forest Service
Northern Region

Montana
Dept of State Lands
Forestry Division

MONTANA FOREST PEST CONDITIONS AND PROGRAM HIGHLIGHTS

1987

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Report 88-2

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INTRODUCTION

This conditions report was prepared jointly by Montana Department of State Lands and USDA Forest Service, Timber, Cooperative Forestry and Pest Management, to summarize pest conditions in Montana during 1987. Major pests on forested lands have been identified and acres affected by pest and ownership have been listed.

Most of the information was obtained from aerial surveys and biological surveys from on-site evaluations.

SUMMARY OF CONDITIONS

Major insect and disease pests continued to degrade the forest health condition and caused economic and esthetic losses in Montana in 1987. Major forest pests that caused widespread damage were mountain pine beetle, root diseases, western spruce budworm, and dwarf mistletoes. Mountain pine beetle outbreaks have continued to decline; however, extensive acres persisted on the Kootenai, Lolo, and Flathead National Forests (NF) in 1987. A small but relatively new outbreak continued to expand on the Deerlodge NF near Butte, Montana. The outbreak of mountain pine beetle on the Gallatin NF and Yellowstone National Park (NP) has subsided and very little activity was detected in 1987. Acres of mountain pine beetle-killed trees detected on all hosts and all ownerships were 707,156 in 1987. This compares to 870,000 acres reported statewide in 1986.

At least 30 percent of the total annual mortality (by volume) Regionwide was caused by root diseases. Results from recent studies have shown that mortality rates of mature trees in infested stands averaged about 3.5 to 4 percent per year for Douglas-fir, and 2 percent for grand fir. Mortality rates for other species were generally lower. Annual volume loss was estimated at 387 MM board feet and may be increasing each year. Lolo and Kootenai NF's incurred the greatest losses. Most other Forests had locally severe infestations as well.

Western spruce budworm defoliation visible from the air was 1.8 MM defoliated acres in 1987. This was a decline from 1986 when 2.5 MM acres were detected. Almost all defoliation was on dry Douglas-fir sites east of the Continental Divide.

Dwarf mistletoe losses slowly declined as infected stands were brought under management. Douglas-fir, lodgepole pine, and western larch were the species most damaged by dwarf mistletoes in Montana. In 1981, 444.4 M acres of commercial timber lands were found to be infested with dwarf mistletoes in Montana. This represents an estimated 18,456 M cubic feet of growth loss to the disease each year. These figures are estimated to have declined by about 4 percent since that time. A sanitation thinning method which was tested on the Flathead Indian Reservation (IR) has proven to be ineffective, making even-aged management our only operational control for the disease.

Fusarium and *Botrytis* continued to cause serious problems in container stock and Fusarium and Pythium root diseases were again problems in bareroot stock at forest nurseries in Montana. Levels of damage remained approximately equal to last year's levels. Recent changes in management practices in some nurseries are expected to significantly reduce losses in the future.

Diplodia blight caused damage to mature, high-value ponderosa pines in 1987, with some trees being killed. The disease continued to increase in severity. Needle cast disease severity was generally low in 1987 with the exception of larch needle blight in stands of west central Montana.

Other bark beetles were observed, but none caused significant losses over wide areas. The forest tent caterpillar caused defoliation of several hardwood species in the Lolo NF and Flathead IR reporting areas.

A leaf-roller, *Archips negundanus* (Dyar), was found severely defoliating several boxelder trees, *Acer negundo* L. in the City of Missoula this year. Though it has been recorded in surrounding states, it was a new record for Montana.

INSECTS

Bark Beetles

Mountain Pine Beetle

Mountain pine beetle-caused mortality in all host species on all ownerships declined to 707,156 acres in 1987 compared to about 870,000 acres in 1986 (Tables 1 and 2). The outbreak on the Gallatin NF and Yellowstone NP is nearly completed and very little mortality occurred in 1987. There are extensive areas in northwestern Montana where the outbreak is still building and causing considerable problems for land managers.

Table 1.--Acres of mountain pine beetle-caused mortality on federal lands in Montana and Yellowstone NP--1986 and 1987.

	1986				1987			
Area	LPP1/	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	167	--	3	--	18	--	1	--
Bitterroot NF	13	1,616	--	--	2	2,713	--	--
Custer NF	13	274	150	--	--	4	--	--
Deerlodge NF	2,377	--	--	--	1,697	1	--	--
Flathead NF	209,312	62	1,246	1,054	181,149	757	551	767
Gallatin NF	6,481	--	578	--	455	--	--	--
Helena NF	2,433	937	--	--	305	403	18	--
Kootenai NF	336,555	4,710	5	631	272,205	2,713	--	1,772
L&C NF	112	1,919	--	--	15	1,124	1	--
Lolo NF	3,202	877	849	39	23,973	736	43	3
TOTAL NF	589,467	10,395	2,831	1,724	479,819	13,092	1,473	2,542
Glacier NP	1,956	--	--	551	1,183	--	--	31
Yellowstone NP	310	--	--	--	--	--	--	--
TOTAL NP	2,266	--	--	551	1,183	--	--	31
Blackfeet IR	704	--	--	--	41	--	--	--
Crow IR	--	5,301	--	--	--	3,928	--	--
Flathead IR	1,674	1,743	291	--	2,239	1,917	2	--
Ft. Belknap IR	--	405 2/	--	--	--	155 2/	--	--
N. Cheyenne IR		2,556	--		--	693	--	--
Rocky Boy's IR	355	593	--	--	24	17	--	--
TOTAL IR	2,733	10,598	291	--	2,304	6,710	2	--
TOTAL BLM	3,994	1,762	--	--	3,668	593	--	--
TOTAL FEDERAL	598,460	22,755	3,122	2,275	486,974	20,395	1,475	2,573

1/ LPP = lodgepole pine PP = ponderosa pine WBP = whitebark pine WWP = western white pine

2/ Nearly all acres affected are on adjacent BLM lands north of Zortman but reported as IR lands

Table 2.--Acres of mountain pine beetle-caused mortality on State and private lands, 1986-1987.

	1986				1987			
Area	LPP 1/	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead	--	--	--	--	6	--	--	--
Bitterroot	--	3,329	--	--	1	2,361	--	--
Custer	1	25	272	--	--	--	--	--
Deerlodge	218	5	--	--	300	--	--	--
Flathead	67,814	3,973	--	174	51,071	12,167	--	71
Gallatin	2,354	--	40	--	311	--	--	--
Garnets	3	1,567	--	--	53	1,392	--	--
Helena	280	1,008	60	--	116	167	1	--
Kootenai	77,254	3,788	--	230	36,040	3,180	127	--
Lewis & Clark	128	2,851	--	--	106	191	--	--
Lolo	16,101	3,110	1	1	22,063	1,169	1	--
Stillwater SF	51,212	101	885	1,617	58,717	647	420	--
Swan River SF	--	--	--	--	4	1		279
Thompson River SF	1,961	187	--	--	4,570	207	--	--
TOTALS	217,326	19,944	1,258	2,022	173,358	21,482	549	350

1/ LPP = lodgepole pine PP = ponderosa pine WBP = whitebark pine WWP = western white pine

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Beaverhead Reporting Area - Mortality in this reporting area has subsided. In 1986 there were 167 acres of infested lodgepole pine stands. This year only 93 acres on all ownerships were reported infested. However, extensive susceptible stands remain in the Pioneer Mountains on the Wise River and Wisdom Ranger Districts.

Bitterroot Reporting Area - Most of the mortality in Montana was in ponderosa pine where 2,713 acres were observed on Federal lands and 2,361 acres on State and private lands. The majority of the infestation was in the East and West Fork drainages of the Bitterroot River, and Grouse Butte area near Darby. A significant amount of the outbreak was in French Basin on State and private lands. Because of the dry conditions in 1987, many of the current year's attacked trees were faded by early October. This outbreak is expected to continue.

Custer Reporting Area - Beetle activity on the Custer was minimal in 1987. There were only 4 acres of ponderosa pine affected on Federal land and none on State and private land in 1987. In 1986 there were 422 acres of mortality in white bark pine and 299 acres of mortality in ponderosa pine.

Deerlodge Reporting Area - A total of 1,997 acres of lodgepole pine stands were infested with the mountain pine beetle on all ownerships in 1987. This compared to 2,595 acres in 1986. Most of these acres were confined to the new outbreak east of Butte, Montana, which has caused concern to local land managers. Biological evaluations indicated that the outbreak will continue.

Flathead Reporting Area - Infested acres of mountain pine beetle killed trees in 1987 were 246,533 on all ownerships and all hosts. This compared to more than 283,000 acres in 1986. Although the outbreak is declining, there was a three-fold outbreak increase in ponderosa pine on State and private land.

Gallatin Reporting Area - The large outbreak reported in the past declined to 766 acres in 1987. Most of these acres occurred in the Yellowstone drainage and in the Crazy Mountains north of Livingston. The older outbreak area in the west Gallatin has subsided and aerial surveys were not conducted on this area in 1987. Extensive areas of dead timber remains as evidence of this outbreak.

Garnets Reporting Area - Most of the beetle activity in this area was in ponderosa pine stands in the Potomac area and along the Clark Fork River where 1,445 acres on State and private lands were infested this year. Approximately the same number of acres were infested in 1986.

Helena Reporting Area - There were 421 acres of lodgepole pine and 570 acres of ponderosa pine on all ownerships infested with mountain pine beetle in 1987. This was down from a total of 4,658 acres reported in 1986 on all ownerships for these two hosts. Most of the decrease was in the Deep Creek area.

Kootenai Reporting Area - Infestations in this reporting area were the most severe in Montana in 1987 on all ownerships. A total of 321,537 acres were infested on all ownerships and all host species. This was down slightly from 423,173 acres observed in 1986. Most of the activity was in the Fisher River drainage and areas surrounding the reservoir above the Libby Dam. The older outbreak areas in the Yaak River drainage have declined.

Lewis and Clark Reporting Area - Activity in this area continued to decline with only 1,532 acres infested on all ownerships and all species. This compared with 5,010 acres in 1986. Most beetle activity occurred in ponderosa pine in the Judith River drainage, and the Belt, Pilgrim, and Tenderfoot Creek drainages.

Lolo Reporting Area - Mortality decreased in this unit in 1987 with 48,493 acres infested. About half of the infestation was on State and private lands. The infestation in the Ninemile drainage continued to increase.

Glacier National Park - This outbreak continued to decline with only 1,183 acres of lodgepole pine infested in 1987. Almost all stands with larger diameter lodgepole pine have been infested and what remains alive are small diameter lodgepole pine and non-host trees.

Yellowstone National Park - The massive outbreak previously experienced in this area has collapsed; no mountain pine beetle-infested trees were recorded in 1987.

Blackfeet Indian Reservation - This outbreak is an extension of the Glacier National Park infestation; it has subsided also. This year only 41 acres of infested lodgepole pine were recorded.

Crow Indian Reservation - There was a slight decline in infested acres of ponderosa pine in this area with 3,928 acres recorded compared to 5,301 acres in 1986.

Flathead Indian Reservation - Infested lodgepole pine was observed on 2,239 acres this year. In addition 1,917 acres of infested ponderosa pine stands were detected on the Flathead Reservation. This compared to 1,674 acres of lodgepole and 1,743 acres of ponderosa pine reported in 1986.

Fort Belknap Indian Reservation - Only 155 acres of infested ponderosa pine stands were detected in 1987. Most of the area was adjacent to BLM lands. Last year 405 acres of infested ponderosa pine were observed. This 6-year-old outbreak is declining.

Northern Cheyenne Indian Reservation - Less than 700 acres of infested ponderosa pine were observed this year compared to 2,556 acres in 1986. The activity east of Lame Deer has declined.

Rocky Boy's Indian Reservation - Only 17 acres of infested ponderosa pine and 24 acres of lodgepole pine were reported this year. This is a significant decrease from 1986.

Stillwater State Forest - Infestation areas remained approximately the same as the previous year with 59,784 acres of all host species recorded on State and private ownerships.

Swan River State Forest - Beetle activity in western white pine continued, and some new infestation in lodgepole pine was noticed. Infestation levels in lodgepole will likely increase in the next few years.

Thompson River State Forest - Infested acres of lodgepole pine on State and private lands more than doubled in 1987, with 4,570 acres recorded. Mortality also continued in some large-diameter, high-value ponderosa pines.

Douglas-fir Beetle

Douglas-fir beetle activity remained low in Montana during 1987 (Table 3). Most of the loss, 126 acres of infested trees, was on the Flathead IR. The Lolo reporting area recorded 108 acres of infested trees on all ownerships.

Spruce Beetle

Only 387 acres of spruce beetle infestation were observed in 1987, mostly on the Flathead IR (Table 3).

Western Balsam Bark Beetle

Scattered mortality, caused by this beetle occurred on 227 acres of subalpine fir in Yellowstone NP (Table 3). Another 54 acres of infested stands were detected on State and private lands within the Gallatin reporting area.

Pine Engraver

Pine engraver activity that could be detected on the aerial survey was low in 1987 with only 17 acres observed (Table 3). Because of the 1987 drought, we expect an increase in Ips activity in 1988.

Western Pine Beetle

Though not reflected by the aerial survey results, on-ground observations indicated increased activity in the western part of the State by western pine beetle. Mortality from the beetle of single ponderosa pines and small groups was found in several areas in 1987. Activity of western pine beetle in past years in Montana has been limited primarily to lightning-struck and other stressed trees. The increased mortality observed in 1987 may have been due to increased moisture stress in ponderosa pine stands on drier sites caused by the extremely dry summers of 1986 and 1987.

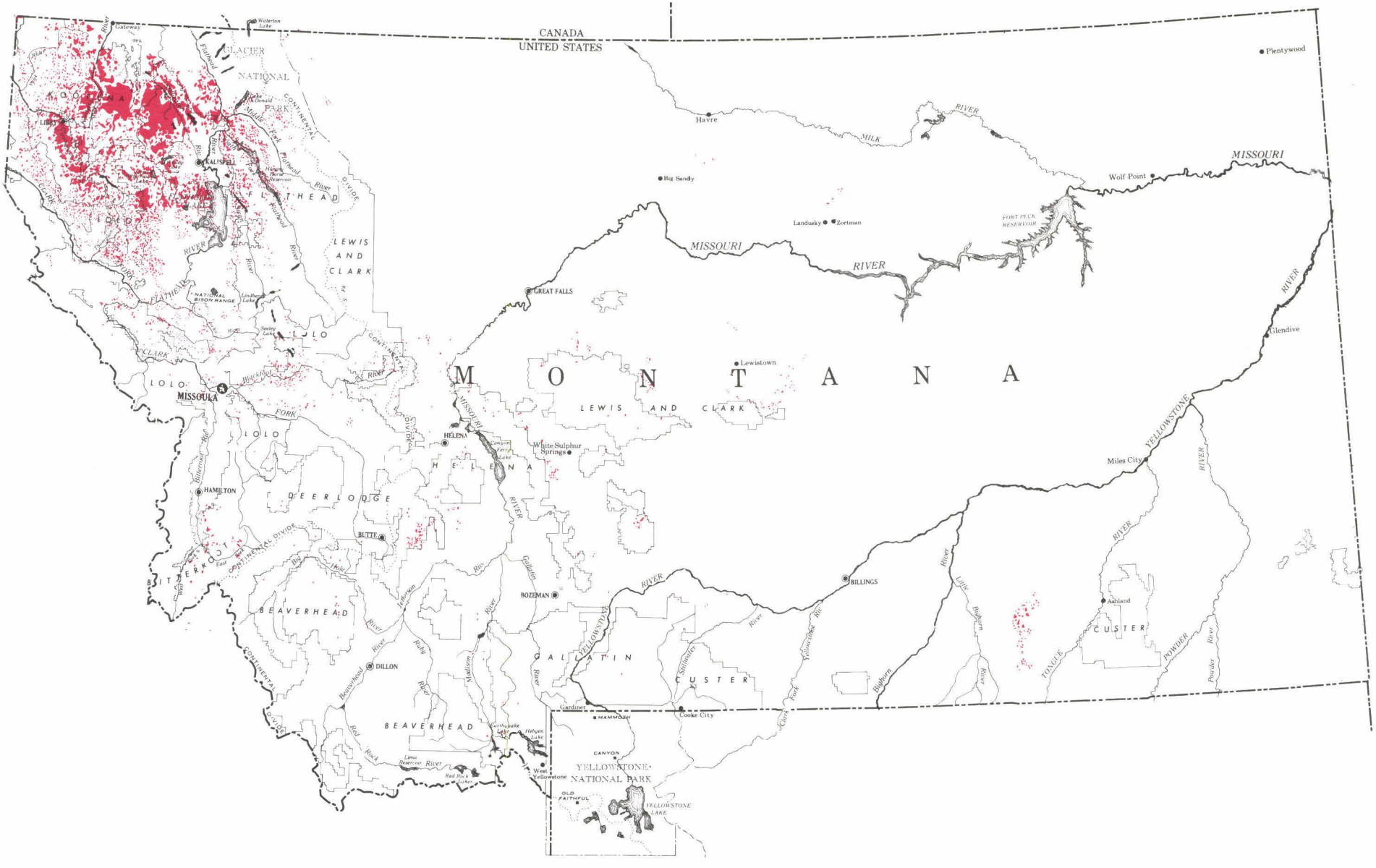
Ash Bark Beetle

Populations of ash bark beetle increased dramatically in many areas of north-central and northeastern Montana in 1987. Buildup was due to the large amount of branch dieback caused by severe spring

freezes that occurred in both 1986 and 1987. Green ash in cities and shelterbelts were most affected in Havre, Glasgow, and the Lewistown area. Beetle activity was mainly confined to weather-damaged branches and trunks of severely stressed trees. Beetle activity is expected to continue in these areas in weather-damaged trees, but healthy trees should not be affected.

Table 3.--Acres of bark beetle-caused mortality (other than mountain pine beetle) in Montana and Yellowstone National Park--1987.

	Douglas-fir beetle		Spruce beetle		Pine engraver		Western balsam bark beetle	
Area	Federal	State & private	Federal	State & private	Federal	State & private	Federal	State & private
Beaverhead	--	--	1	--	--	--	14	1
Bitterroot	--	--	2	--	10	--	--	--
Custer	--	--		--	--	--	--	--
Deerlodge	--	--	1	--	--	--	--	--
Flathead	3	--	6	--	--	--	6	1
Gallatin		1	--	--	--	--	4	54
Garnets	10	4	--	--	--	--	1	--
Helena	2	2	--	--	--	--	4	--
Kootenai	2	--	--	--	--	--	--	--
Lewis & Clark	1	--	--	--	--	7	--	--
Lolo	98	10	--	--	--	--	--	--
Glacier NP	--	--	--	--	--	--	--	--
Yellowstone NP	--	--	--	--	--	--	227	--
Blackfeet IR	--	--	--	--	--	--	4	--
Crow IR	--	--	--	--	--	--	--	--
Flathead IR	126	--	378	--	--	--	3	--
Ft. Belknap IR	--	--	--	--	--	--	--	--
N. Cheyenne IR	--	--	--	--	--	--	--	--
Rocky Boy's IR	1	--	--	--	--	--	--	--
BLM	1	--	--	--	--	--	10	--
Stillwater SF	--	--	--	--	--	--	--	--
Swan River SF	--	--	--	--	--	--	--	--
Thompson River SF	--	--	--	--	--	--	--	--
TOTAL	244	18	387	--	10	7	280	56



Areas of mountain pine beetle infestations in Montana and Yellowstone National Park (all host species), 1987.

Defoliators

Western Spruce Budworm

There has been a decline in budworm defoliation in the State compared to the past 10 years. In 1987 there were 1,806,469 acres of defoliation, mostly on the Helena, Deerlodge, and Lewis and Clark reporting areas (Figure 2). This compared to over 2.5 MM acres observed in 1986 (Table 4).

There was a planned control project on the Gallatin NF in an area that was treated with *Bacillus thuringiensis* (*B.t.*) in 1986. However, the effects of treatment carried over into 1987 and populations did not warrant control. Nearby untreated check areas received considerable defoliation.

Table 4.--Acres of aerially visible western spruce budworm defoliation, on all ownerships, in Montana and Yellowstone National Park--1986 and 1987.

	Total acres - all ownerships		1987 acres by ownership				
Area	1986	1987	NFS	NPS	BIA	BLM	State & private
Beaverhead	318,194	279,827	178,934	--	--	53,761	47,132
Bitterroot	60,149	60,709	49,137	--	--	--	11,572
Custer	29,388	24,910	24,910	--	--	--	--
Deerlodge	501,854	442,404	226,862	--	--	52,606	162,936
Flathead	6,616	--	--	--	--	--	--
Gallatin	276,315	71,1927	44,2464	--	--	--	52,863
Garnets	199,350	63,615		--	--	10,752	52,863
Helena	826,265	659,549	336,410	--	--	39,389	283,750
Kootenai	--	--	--	--	--	--	--
Lewis & Clark	174,056	119,573	107,794	--	--	1,650	10,129
Lolo	85,511	62,051	57,403	--	--	60	4,588
Glacier NP	--	--	--	--	--	--	--
Yellowstone NP	7,834	4,464	--	4,464	--	--	--
Blackfeet IR	--	--	--	--	--	--	--
Crow IR	4,260	--	--	--	--	--	--
Flathead IR	14,569	18,175	--	--	18,175	--	--
N. Cheyenne IR	--	--	--	--	--	--	--
Rocky Boy's IR	--	--	--	--	--	--	--
TOTAL	1,504,361	1,806,469	1,025,696	4.464	18,175	158,218	599,916

Douglas-fir Tussock Moth

In 1982 and 1983 there were increases in trap catches of male moths in western Montana. No defoliation was detected and the populations subsided in 1984.

Trap catches in 1987 indicated the population in Montana remained at endemic levels. Only one plot near St. Ignatius had trap catches of more than 25 moths per trap. Some defoliation of ornamental blue spruce by Douglas-fir tussock moth was noted in 1987 in Kalispell and Missoula.

Gypsy Moth

Gypsy moth is confirmed to be established in northern Idaho; however, only isolated trap catches have occurred in Montana in the past. No gypsy moth males were caught in detection traps in Montana in 1987. Trapping in 1988 will be coordinated between Montana Department of State Lands, State Department of Agriculture, APHIS, and the USDA Forest Service.

Lodgepole Terminal Weevil

Lodgepole terminal weevil surveys conducted in 1987 indicated a general decrease in infested terminals in affected areas. Only a sample of the areas known to be affected was examined. We are not certain why there was a decline, but believe it is only temporary. In the past many stands surveyed in western Montana had infestation rates near 11 percent for a single year. As more stands grow into susceptible size classes we expect the incidence of terminal weevil damage to increase.

Forest Tent Caterpillar

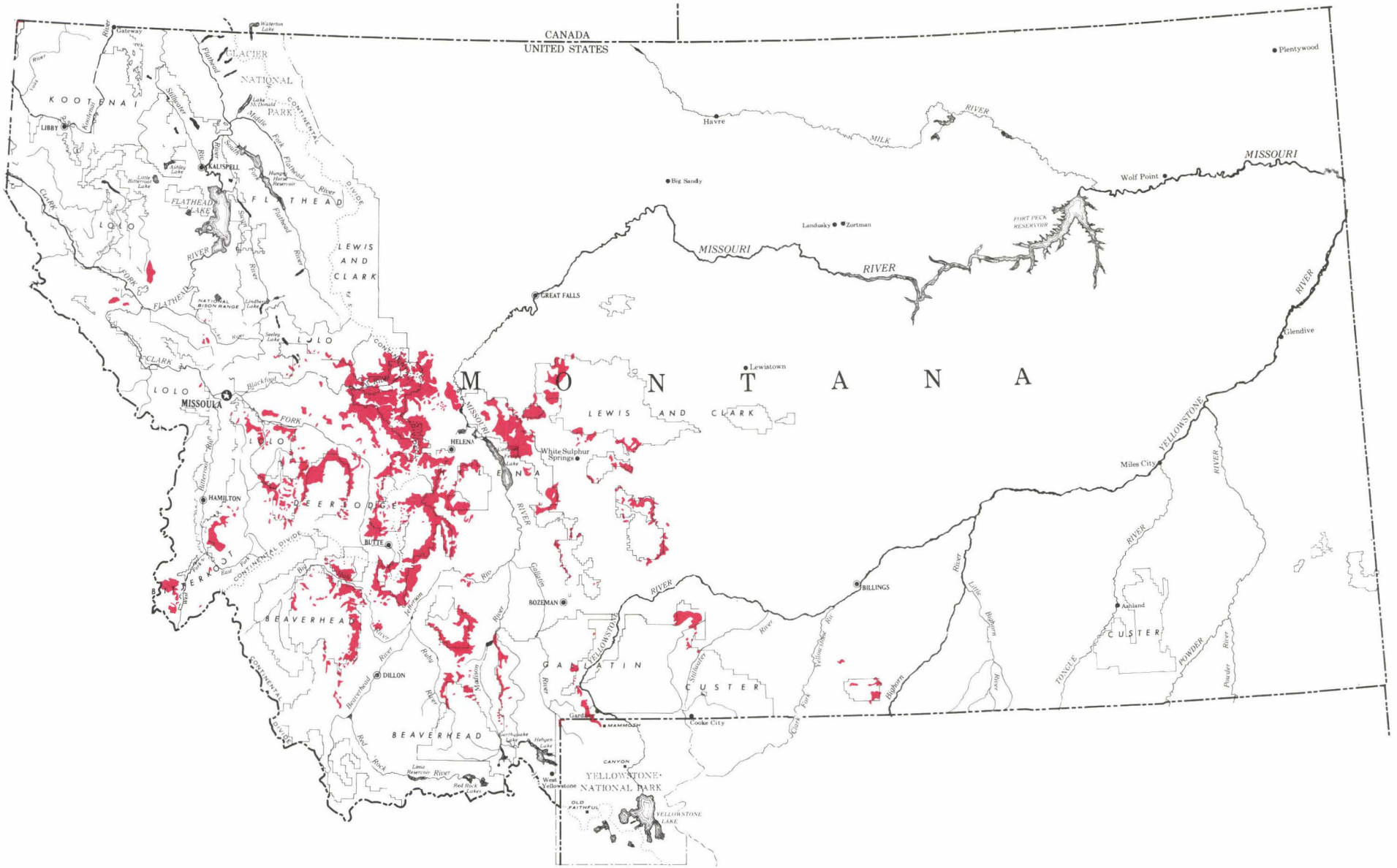
Forest tent caterpillars continued to defoliate hardwoods along the major drainages east and west of Missoula for the third year. It was also observed in the Flathead IR. Biological surveys indicated that populations should decline in 1988.

Elm Leaf Beetle

Extensive defoliation of Siberian elms by the elm leaf beetle occurred in 1987 in Miles City and to a lesser extent in Billings, Forsyth, and other eastern locations. Trees affected in Miles City were already stressed by lack of moisture. If drought conditions and defoliation continue in 1988, some tree mortality could occur.

Alder Flea Beetle

Defoliation of alders along streams by this beetle was noted in many areas around Missoula in 1987.



Western spruce budworm defoliation visible from the air in Montana and Yellowstone National Park, 1987.

DISEASES

Root Diseases

Root diseases were the major impacting diseases in western Montana. *Armillaria obscura* causes most of the root disease damage in Montana, but other root pathogens were also locally important in the State.

Phellinus weirii was most damaging in Montana on the Lolo and Kooenai NF's. On the Lolo, it is found on grand fir and western hemlock habitat types. Douglas-fir is the most damaged species.

Fomes annosus has caused considerable mortality in commercially thinned ponderosa pine stands on the west side of the Flathead IR. Concern that the practice of commercial thinnings of stands has lead to intolerable levels of damage due to stump infection by *F. annosus* has lead to an evaluation of stump infection in a current timber sale on the reservation. Results will be forthcoming in 1988.

A hazard-rating system was recently devised for stands on the Lolo NF. The system is based upon the probability of occurrence of root disease on sites of various types. Habitat type was found to be closely tied to root disease occurrence with grand fir and western hemlock having very high probabilities of root disease. Aspect and land form class was also associated with root disease occurrence on Douglas-fir and subalpine fir habitat types. A report of these and other findings is in preparation by the Northern Region USDA Forest Service pest management personnel and the USDA Forest Service Methods Application Group.

Mortality rates over a broad range of stand conditions are the subjects of two root disease projects in northern Idaho. These are probably applicable to conditions in western Montana as well. A project to monitor tree mortality in three compartments of the Fernan RD (Idaho Panhandle NF) was established in 1985 and re-examined annually for 3 years. Annual mortality rates fluctuated considerably for western larch, ranging from 0.7 percent to nearly 3 percent per year. Douglas-fir and grand fir mortality rates have remained constant at about 4 and 2 percent per year, respectively. The rate of mortality of Douglas-fir killed by root diseases is greater than that of western white pine killed by blister rust (2.5 percent per year).

The second project was started in 1987 on the Lochsa RD of the Clearwater NF. Permanent plots were established over a 17,000-acre compartment. Mortality from all causes will be monitored on an annual basis similar to the Fernan project.

All plots were established and are monitored by District personnel with training and financial support from the Regional Office of the USDA Forest Service (Missoula). These projects will be used in development of a root disease hazard-rating system to provide needed information for planning harvest activities. It will help to identify stands which are losing or will soon be losing the greatest volumes of timber. These stands can be scheduled for harvest to avert much of the loss of value due to root disease mortality. Information from hazard ratings will also be used to assess root disease impact over large areas and adjust productivity projections for stands and compartments. Additionally, the Fernan project includes many stands which are scheduled for commercial thinning. They will be monitored following thinning to evaluate the effects of thinning on mortality rates.

Stem and Branch Diseases

Dwarf Mistletoes

Dwarf mistletoes attack most conifer species throughout Idaho. Severe infections may reduce tree growth, wood quality, and cone crops, and predispose trees to attack by other agents such as bark beetles. Dwarf mistletoe management considerations were incorporated into many timber management plans and silvicultural prescriptions. Concurrently, dwarf mistletoe suppression projects were conducted to reduce acreage of previously harvested stands in which infected trees were left and are above established regeneration. The dwarf mistletoe management program is a sequential process of education, presuppression survey, evaluation, control, and postcontrol evaluation.

a dwarf mistletoe evaluation was made on the Flathead IR. Beginning in the 1970's, highly infested stands, those with one third or fewer of the stems infected, were targeted for uneven age management. All visibly infected trees of merchantable size were cut during the first entry. Infected precommercial trees were removed during a followup precommercial thinning. The intent was to remove any missed trees and newly infected trees in subsequent stand entries. However, a 1987 evaluation showed that many trees were infected 8-10 years following treatment, too many to remove in the next entry. In some stands, 30-60 percent of the Douglas-fir and/or western larch were infected. Some trees were severely infected, with dwarf mistletoe intensity ratings of 4, 5, and 6 based on the 6-point rating system. The apparent cause of failure was an inability to reliably distinguish infected from uninfected trees at the time of treatment. Many trees that appeared free of infection were in fact severely infected. Release of these trees following partial cutting stimulated the dwarf mistletoe to form brooms which then became apparent. The Flathead Reservation is currently in the process of revising prescriptions for dwarf mistletoe-infested stands.

Stem Cankers

White Pine Blister Rust

Losses from this disease continue to decline as harvested stands are regenerated with more resistant white pine stock and mixtures of other species. The western white pine management guide, compiled by CFPM, the Intermountain Station, and the Clearwater IR, will be available shortly. Recent evaluations have been completed to determine the biological and economic feasibility of pruning and canker excising in young, high value white pine stands. These techniques have reduced lethal infection to an average of 12 percent in crop white pines compared to 87 percent in untreated white pines in the same stands. The benefit/cost ratio for treated stands was 4.6 at culmination of mean annual increment. A report of the project (Hagle and Grasham 1988) has been prepared by USDA Forest Service, Timber, Cooperative Forestry and Pest Management, and Palouse IR.

Blister rust in whitebark pine has become an item of interest as it relates to grizzly bear habitat. Whitebark pine stands in the greater Yellowstone area are affected by white pine blister rust. Tree mortality may be a factor in limiting whitebark pine cones which are considered an important food source for grizzly bear.

Stalictiform and Comandra Blister Rusts

Stalactiform blister rust can be locally important in lodgepole pine stands and comandra blister rust can be locally important in both lodgepole pine and ponderosa pine stands. Both fungi are most damaging in lodgepole pine stands east of the Continental Divide. Stalactiform blister rust was common in stands on the Gallatin NF, and both diseases caused extensive losses in some stands on the Beaverhead NF. Stalactiform blister rust was severe in lodgepole pine regeneration in some stands on the Wise River RD of the Beaverhead NF.

A computerized hazard-rating system for comandra blister rust was recently devised by Colorado State University and the Rocky Mountain Forest Experiment Station. The system was developed in part from stand data the Beaverhead National Forest. Persons interested in testing this system on the Beaverhead and adjacent lands should contact TCFPM in the Regional Office of the Northern Region.

Diplodia blight

Severe infections by *Diplodia pinea* on ponderosa pine branches were noticed first in western Montana a few years ago. Since that time the disease has been discovered to be widespread and damaging. In 1987, many trees, particularly along the west side of Flathead Lake, died from severe Diplodia infections and subsequent bark beetle attack. Most of these trees were mature dominants and codominants, highly visible from the highway.

Nursery Diseases

Fusarium Root Disease

Fusarium root disease remained one of the major problems of containerized seedling production in forest tree nurseries. Several species of *Fusarium* have been identified as commonly associated with and capable of causing damping-off of young germinants and root disease of older seedlings. The two most common species are *F. oxysporum* and *F. acuminatum*. Strains of both species include pathogens and saprophytes. Occurrence of *Fusarium* on the roots of nondiseased containerized seedlings is quite common. Conditions which promote disease development from these infections are being investigated. *Fusarium* spp. commonly reside within and are often transmitted from one crop to another on containers. Standard procedures used to clean containers does not eliminate *Fusarium* within them. Additional tests are planned to evaluate techniques of reducing container-borne inoculum.

Tests to reduce amounts of *Fusarium* on and within conifer seed indicate that running water rinses, hot water treatments, and a rapid soak in concentrated ethanol can be effective. Exact exposure periods required for adequate cleaning without reducing germination are still being formulated.

Evaluations are being conducted to determine the fate of *Fusarium* spp. on the roots of nondiseased containerized seedlings following outplanting. On one site, *Fusarium* was found still colonizing some roots 1 year after outplanting, but was not associated with any seedling mortality that occurred on the site. In another outplanting for tree improvement purposes on a nonforest site, *Fusarium* was responsible for scattered Douglas-fir seedling mortality 1 year after outplanting.

Evaluations are also planned to develop more satisfactory methods for controlling *Fusarium* diseases of conifer seedlings. Approaches include chemical, biological, and cultural treatments.

Grey Mold

Grey mold continued to cause losses primarily of containerized seedlings during the latter portion of production cycles and during storage. Because this disease causes most damage to western larch in the northern Rocky Mountains, investigations were conducted to elucidate the infection biology of the fungus on this species. The primary goal of the work was to formulate more effective control measures. Preliminary work indicates that the fungus can penetrate needles directly and that older senescent needles are much more easily infected. Residual deposits of commonly used fungicides on needle surfaces affect spore germination and infection processes. Extent of these effects appears related to pesticide formulations and concentrations.

Meria Needle Cast

This disease was effectively controlled in bareroot western larch seedlings by application of protective fungicides. Warm, dry weather during periods of potential infection also contributed to low disease incidence.

Sirococcus Tip Blight

This disease was again located on containerized Engelmann spruce seedlings and infrequently on bareroot pine and spruce seedlings at several nurseries. Fungicide applications have helped keep losses from this disease at relatively low levels.

Pythium Root Disease

Root disease of containerized western white pine seedlings associated with a Pythiaceous-type of fungus was detected. The associated fungus, which has not yet been identified, rapidly decays lateral roots of affected seedlings. Foliar symptoms are not common and diseased seedlings are discovered only during extraction from containers.

Stem Decay

Pini Decay

Stem decay caused by *Phellinus pini* (red ring rot or pine rot) continued to be the most damaging stem decay in Montana. Lodgepole pine, western larch, Douglas-fir, western white pine, Englemann spruce, and occasionally, ponderosa pine were affected by this disease. Losses were great in some stands, particularly unmanaged old growth.

Schweinitzii Butt Rot

Butt rot in Douglas-fir and old-growth ponderosa pine continued to be a major source of volume loss in many stands in Montana. Management which emphasizes shorter rotations is expected to alleviate most of this damage in future crops, but as long as we are harvesting old-growth stands we can expect substantial cull losses from this disease.

Indian Paint Fungus

Indian paint fungus (*Echinodontium tinctorium*) was the major cause of defect in mature true fir and hemlock in stands in western Montana. A model to predict impact of this disease in grand fir stands developed for the Blue Mountains of Oregon will be tested for its applicability in stands in Idaho and Montana.

Aspen Stem Diseases

Aspen canker and trunk rot were common in many aspen stands in Montana, particularly east of the Continental Divide.

Foliage Diseases

Larch Needle Blight

Hypodermella laricis was locally severe in 1987. Many stands on the west side of the Lolo National Forest and southwestern Kootenai National Forest were severely infected by the fungus. The damage was highly visible in June, and blighted spurs remained visible during the winter months. The high inoculum levels in these stands may lead to continued severe infections if the spring weather is wet.

Ponderosa Pine Needle Cast

Elytroderma needle cast was common in ponderosa pines growing near bodies of water in Montana. Although this disease usually causes little damage, severe, chronic infection continued to cause deformation and occasional death of regeneration in multistoried pine stands along the west shore of Flathead Lake.

Vascular Wilts

Dutch Elm Disease

Dutch elm disease was first reported in Montana in 1973 in Missoula. In 1977, it was found in Ravalli County and subsequently in Billings and Forsyth. Large numbers of elms have been killed.

In 1987, Dutch elm disease was reported on two trees in Great Falls. A survey conducted in July in Great Falls by the Department of State Lands confirmed the presence of the disease. A total of 155 trees were observed that showed possible Dutch elm disease symptoms. Twig samples for laboratory culture to positively confirm the disease were taken from 23 trees. Cultures were positive for Dutch elm disease for 19 of the 23 trees.

A survey for Dutch elm disease was also conducted in Forsyth in September by the Department of State Lands. A total of 205 elms were observed which showed possible Dutch elm disease symptoms of some degree, ranging from totally dead to wilting of a single branch. Twig samples for laboratory culture were taken from four representative trees; all four tested positive.

The disease killed more than 200 elms in Billings in 1987.

Verticillium Wilt

A vascular wilt disease of maples was identified for the first time in Bonner (near Missoula) at a private residence. Several trees in a lawn were dead or dying from this disease. The city of Missoula will be training pruning crews to identify the symptoms of this disease and inspecting city maples this summer to evaluate the extent of the disease.

Abiotic Damages

Drought

Trees throughout Montana were showing symptoms of drought stress. While most trees experienced less than normal growth, some trees lost a great deal of foliage and others, particularly some seedlings, died from water stress. It appears likely that many trees will go into this growing season in a drought-stressed condition.

RECENT PUBLICATIONS

Bousfield, Wayne, Frank Cifala, and Richard Kracht. 1987. Western spruce budworm control project on the Big Timber Ranger District, Gallatin National Forest, Montana. USDA Forest Service, Northern Region. Rept. 87-8. 5p.

Gast, Sandra, and Kenneth E. Gibson. 1987. Mortality factors associated with laboratory reared Douglas-fir tussock moth larvae: A case study USDA Forest Service, Northern Region. Rept. 87-4. 8p.

Gibson, Kenneth E., and Robert D. Oakes. 1987. Mountain pine beetle status report, Northern Region. 1986. USDA Forest Service, Northern Region. Rept. 87-7

Gibson, Kenneth E., Susan K. Hagle, and Steve Kohler. 1987. Montana forest pest conditions and program highlights 1986. USDA Forest Service, Northern Region, and Montana Dept. of State Lands, Forestry Division. Rept. 87-2. 29p.

Hagle, Susan K.; Goheen, D. J. 1988. Root disease response to stand culture. *In*: Future Forests of the Intermountain West; a stand culture symposium: Proceedings; 1986, September 28-October 2; Missoula, MT. General technical report INT-000. Ogden, UT: USDA Intermountain Forest and Range Experiment Station.

Hagle, Susan K.; Grasham, J. L. 1988. Biological and economic feasibility of pruning and excising cankers in white pine plantations to control blister rust. Report No. 88-00. Missoula, MT. USDA Forest Service, Northern Region.

Hagle, Susan K., Scott Tunnock, Kenneth E. Gibson, and Carma J. Gilligan. 1988. Field guide to diseases and insects of Idaho and Montana forests. Missoula, MT. USDA Forest Service, Northern Region. 123 p.

James, R. L. 1987. Occurrence of *Fusarium* on conifer tree seed from Northern Rocky Mountain nurseries. *In*: Landis, T. D. (tech. coord.). Proceedings: Combined Western Forest Nursery Council and Intermountain Nursery Association Meeting. USDA Forest Service, Gen. Tech. Rept. RM-137. pp. 109-114.

James, R. L. 1987. Effects of water rinse treatments on occurrence of fungi on spruce seed from the Towner Nursery, North Dakota. USDA Forest Service, Northern Region. Rept. 87-5. 4p.

James, R. L. and J. Y. Woo. 1987. Pathogenicity of *Alternaria alternata* on young Douglas-fir and Engelmann spruce germlings. USDA Forest Service, Northern Region. Rept. 87-9. 4p.

James, R. L., J. W. Schwandt, and J. Y. Woo. 1987. An evaluation of fungicides to control Diplodia tip blight at the Fantasy Farms Nursery, Peck, Idaho. USDA Forest Service, Northern Region. Rept. 87-10. 4p.

James, R. L. 1987. Containerized western larch seedling mortality, USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region. Rept. 87-11. 7p.

James, R. L. 1987. Mortality of bareroot Colorado blue spruce seedlings- Montana State Nursery, Missoula. USDA Forest Service, Northern Region. Rept. 87-12. 6p.

James, R. L., R. K. Dumroese, D. L. Wenny, J. F. Myers, and C. J. Gilligan. 1987. Epidemiology of *Fusarium* on containerized Douglas-fir seedlings. 1. Seed and seedling infection, symptom production and disease progression. USDA Forest Service, Northern Region. Rept. 87-13. 22p.

Kohler, S. 1987. Dutch elm disease survey, Great Falls, Montana. Montana Dept. of State Lands, Forestry Div. Unpublished report, 14p.

Kohler, S. 1987. Dutch elm disease survey, Forsyth, Montana. Montana Dept. of State Lands, Forestry Div. Unpublished report, 10p.

Stipe, L. E., R. L. James, R. L. Livingston, J. W. Schwandt, D. P. Beckman, K. A. Knapp, J. Hoffman, and J. Weatherby. 1987. Idaho forest pest conditions and program summary-1986. USDA Forest Service, Northern and Intermountain Regions, Idaho Dept. of Lands. Rept. 87-1. 32p.